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Schutte & Koerting

BAROMETRIC CONDENSERS

The Barometric Condenser is employed in a variety of industries as an economical means of removing air, exhaust steam, and other vapors from vacuum equipment. It has been used for decades in the food industry for processing edible oil, milk and other products - for nearly a century in sugar refining. Other industries using the Barometric Condenser include alcohol plants and distilleries, pulp and paper mills, petroleum refineries, salt manufacturing plants and a host of chemical plants of varied nature. Thus, the Barometric Condenser is found in almost every area of the Chemical and Process Industries which use vacuum stills, calandria pans, multiple-effect evaporators, vacuum crystallizers, and high-vacuum water and process cooling equipment.

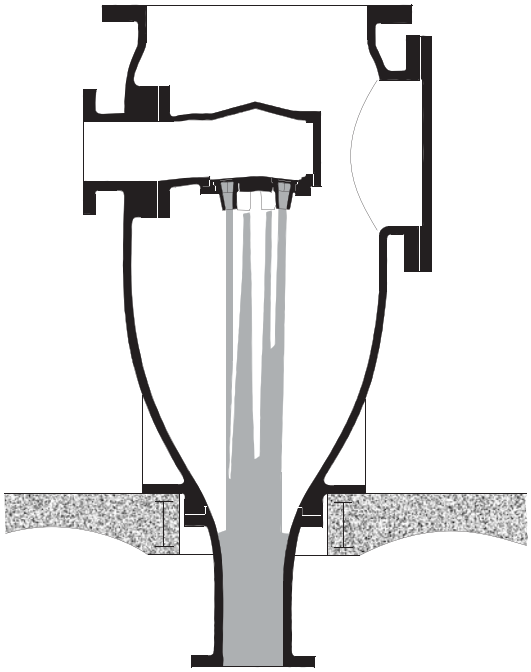
A principal feature of the Barometric Condenser is that injection water may be discharged through a tail pipe by gravity, without requiring a pump. Another advantage of such condensing equipment is its immunity from flooding, in the event of priming or liquid entrainment. In most plants, the vapor exhaust connections of vacuum apparatus are located at considerable elevation above ground level. The Barometric Condenser here permits shorter exhaust vapor lines and provides two further advantages: a reduction of leakage hazard and lower first cost. Since there are no moving parts, maintenance is low. The condenser requires little space and is readily installed.

BASIC TYPES

Barometric Condensers are of two basic types: (1) concurrent, or parallel flow, in which the vapor to be condensed enters at the top of the unit and flows in the same direction as the water, and (2) counter-current, or counter flow, in which the vapor enters near the bottom of the equipment and passes upward against the water flow. Injection water is delivered to the condenser in the form of jets, sprays, water curtains or a combination, depending upon service required.

Barometric Jet Condensers are further classified according to the type of jet action employed. The Multi-Jet type which was first introduced by Schutte & Koerting in 1923 consists of water jets only and operates without air pump. The Barometric M-J Condenser, as it is called, is recommended for operation under fairly constant loads where there is relatively little air leakage, and where water is not too scarce and, therefore, does not need to be recirculated. Sizes range from 50 to 12,000 gpm. No auxiliary air pump is required.

Another type of concurrent condenser developed by Schutte & Koerting is the Barometric M-J-S Condenser, a multi-jet spray type, first introduced to the industry in 1936. The M-J-S Condenser has two water inlets, one near the center which feeds a set of converging jets operating at constant pressure to handle the non-condensables; the other inlet feeds a cycle of variable flow spray nozzles near the top of the unit which performs the majority of the condensing. This combination permits the adjustment of spray water in accordance with variable loads and injection water temperatures without interfering with the vacuum maintained. Sizes range from 500 to 12,000 gpm. No auxiliary air pump is required.



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Also developed by Schutte & Koerting, and first introduced in 1940, was a third type - a concurrent condenser of the Multi-Spray type, known as the Barometric M-S Condenser. This type is recommended where water is in short supply or where an excessive amount of non-condensables requires the use of a steam jet air ejector. Water is fed to the center of variable flow sprays similar to the spray nozzles in the M-J-S Condenser. Non-condensables are removed through an air suction connection located in the central part of the body. A small barometric counter-current condenser is used as a precooler to reduce the load on the steam jet vacuum pump. Sizes range from 500 to 10,000 gpm.

Schutte & Koerting also manufactures Counter-Current Spray or Tray Type Condensers, also known as C-C Barometric Condensers. They are employed where water supply is limited or excessive quantities of non-condensables require a separate vacuum pump, but local conditions necessitate a side vapor inlet and a Multi-Spray Type cannot be installed to advantage. They are also employed to advantage in small sizes. Steam requirements for the air pump depend upon the non-condensable load. Sizes of Schutte & Koerting C-C Barometric Condensers range from 10 to 5,000 gpm.

CONDENSER THEORY

The operation of any condenser is described by a simple heat balance. The heat added up to the system is the quantity of steam being condensed, expressed in pounds per hours, multiplied by the latent heat of vaporization expressed in BTU per pound. This must be equal to the heat removed by the condensing water which is the quantity of water expressed in pounds per hour multiplied by the temperature rise from inlet to outlet times the specific heat (which is 1.0 in the case of water).

It is apparent, therefore, that the larger the temperature rise of the condensing water, the smaller the amount of water required. Under theoretically perfect conditions, a condenser could be operated under a vacuum corresponding to its tail and discharge water temperature, but no higher. Therefore, if water enters at 90°F and took a 10°F rise, the theoretical condenser pressure would be 1.933 inches Hg abs (vapor pressure of water at 100°F).

Under normal operation this, of course, can never occur. Air entering with the injection water and non-condensables entering with the vapor load exert a partial pressure. Ultimate condenser pressure is the sum of the vapor pressure at the tail temperature, plus the partial pressure of the non-condensables present. The difference between the temperature of the tail water and the temperature corresponding to saturated water vapor at the actual condenser pressure is known as the "terminal difference". It is a measure of efficiency of condenser operation.

For example: a condenser operating with 90°F injection water and 10°F temperature rise with terminal difference of 5°F would be operated at 2.244 inches Hg abs (the vapor pressure of water at 105°F).

SELECTING A CONDENSER

The major factors involved in the selection of a type of condenser are: (1) water availability, (2) vacuum requirements, and (3) amount of non-condensables present.

Where low cost water is available in large quantities and without high pumping costs it is usually unnecessary to employ a system for water recirculation or cooling. In this situation the simplest unit (a Barometric Multi-Jet Condenser) is most economical, due to lower first costs and installation costs. If the load conditions are fairly constant, the M-J Condenser should be given first choice provided the non-condensable load is not excessive. If the load varies and if the temperature of injection water varies over a wide range, an M-J-S Condenser will allow throttling of the injection water and would, therefore, be more economical in operation.

If the injection water available is limited, the most suitable choice of a Barometric Condenser would be the one giving the lowest terminal difference, such as a Multi-Spray or Counter-Current Condenser. These condensers, however, require an auxiliary air pump.

Both the M-S and Counter-Current Condensers operate with equal effectiveness. The M-S type is indicated for large sizes due to its compactness and lower costs with the self-draining feature.

This design cannot be utilized in small sizes, however, and therefore, the Counter-Current Condenser is indicated in small sizes or when side vapor inlets are desired.

S&K MULTI-JET (M-J) BAROMETRIC CONDENSERS

APPLICATION

The S&K Multi-Jet Condenser is generally employed where low cost water is available in ample quantity. It is the simplest design of all barometric condensers, and requires no auxiliary air pump or pre-cooler. It is probably the ideal type where load conditions are constant and there is little air leakage. The Multi-Jet Condenser is also used where the vacuum handled is not high and a moderately large terminal difference is permissible.

CONSTRUCTION

Multi-Jet Barometric Condensers are made in two basic designs, the Type 590 and Type 591, as shown in Fig. 1 and Fig. 2.

The Type 591 design is used for the four smallest sizes. It has the water inlet at the top and the vapor inlet at the side. This unit consists of a body (a closed cylindrical chamber), and water nozzle housing at the top water inlet; and jet type water nozzles.

The Type 590 design is used for all sizes above the smallest four. This design has the vapor inlet at the top and the water inlet at the side. It consists of a body; water nozzle case and plate and jet type water nozzles. An inspection cover located directly opposite the nozzle case permits easy access to the nozzles. Supporting brackets, cast on both sides of the body, provide a convenient method of securing the condenser to flooring or beams.

OPERATION

Condensing water is delivered into the nozzle case and ejected through the nozzles. These are carefully designed to handle a specified amount of water at stated pressure and guaranteed vacuum. The water jets are directed into the tail-piece at the lower end of the body, where they unite to form a single jet. Vapors entering the condenser come into direct contact with the converging water and are condensed. Non-condensables are also entrained and discharged by the water jet action.

Terminal difference obtainable with this type of condenser is 11 to 13°F.

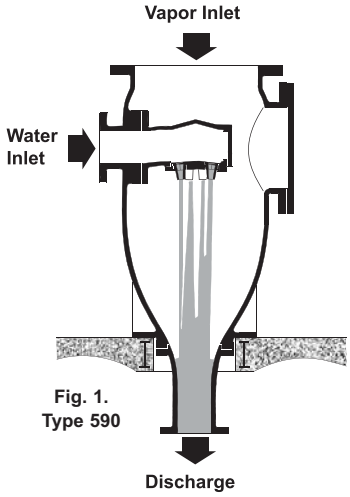


Fig. 1. Type 590

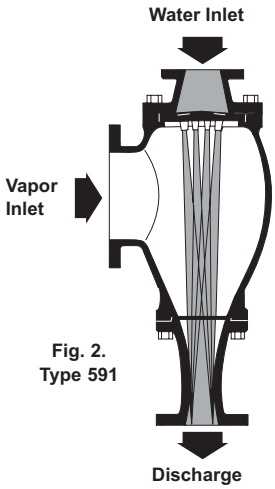
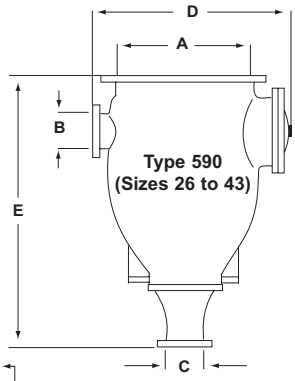
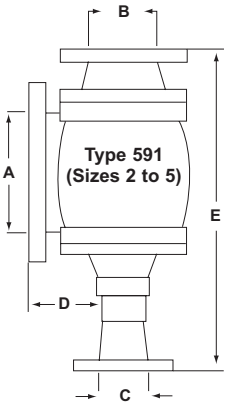


Fig. 2. Type 591

TABLE 1. SIZES, CAPACITIES, DIMENSIONS, AND WEIGHTS OF S&K MULTI-JET, BAROMETRIC CONDENSERS, TYPES 590 AND 591

Size No.	Maximum Water Capacity, gpm	Connections, Inches			Overall Dimensions, Feet and Inches		Approx. Weight, Lb.	
		A	B	C	D	E	C.I.	FAB. ST.
2	50	5	2 1/2	2	7"	23"	500	-
3	85	6	3	2 1/2	8"	30"	550	-
4	130	8	4	3	9"	32"	600	-
5	210	10	4	4	10" 3/4"	36 7/8"	675	-
26	375	14	5	5	2' 4 1/2"	4' 5 3/4"	1300	650
27	425	18	5	5	2' 4 1/2"	4' 5 3/4"	1400	700
28	475	18	5	6	2' 4 1/2"	4' 5 3/4"	1450	725
29	550	20	6	6	2' 6 1/2"	4' 6 1/4"	1600	800
30	625	20	6	6	2' 6 1/2"	4' 6 1/4"	1600	800
31	750	24	6	6	2' 11"	5' 2"	1900	1050
32	950	24	8	8	2' 11"	5' 2"	2000	1300
33	1100	30	8	8	3' 7"	5' 6"	3300	1700
34	1300	30	8	8	3' 7"	5' 6"	3300	1700
35	1700	30	8	10	4' 0"	6' 8 1/2"	5000	2900
36	2200	36	10	10	4' 5"	7' 1 1/4"	6000	3100
37	3200	42	12	12	5' 3"	8' 0"	8000	4000
38	3800	48	12	12	5' 7 1/2"	8' 8"	9500	5000
39	5000	54	14	14	6' 4"	10' 2"	11000	
40	6000	60	16	16	7' 6 1/2"	11' 10"	14000	
41	8000	60	18	18	7' 6 1/2"	11' 10"	16000	
42	9000	66	20	20	8' 4"	13' 4"	20000	
43	12000	72	24	24	9' 0"	14' 2"	22000	





S&K MULTI-JET SPRAY TYPE (M-J-S) BAROMETRIC CONDENSERS

APPLICATION

S&K Type 592 M-J-S Condensers are generally employed where large capacities are required and where wide fluctuations in water temperature or steam load occur. They are used extensively in canneries, in sugar, milk, and other food plants; in pulp and paper mills, distilleries; petroleum refineries, and a wide variety of chemical and salt manufacturing companies.

The flexibility of operation achieved by this condenser is apparent from its design. For full vapor load the rated water capacity is passed through both the spray and jet nozzles. If the load or water temperature decreases, it is possible to throttle the water to the spray nozzles and ultimately turn them off completely. In the latter case, the condenser is operating similar to the Multi-Jet type previously described, but with a minimum of injection water under the given conditions.

CONSTRUCTION

S&K Multi-Jet Spray Barometric Condensers consist of a body, a water nozzle case and plate with jet type nozzles, and spray type nozzles which are threaded into the body and fed by means of a ring cast at the top of the condenser. Water enters through the two inlets, leaving from the lower nozzles in the form of converging jet streams and from the upper nozzles in the form of converging sprays. The spray nozzles are of special non-clogging design with the spiral case integral with the nozzle body. For details on these nozzles, see page 12.

The spray nozzles are readily accessible from the outside by means of hand-holes located opposite each nozzle. The jet nozzles are accessible for inspection through an opening in the side of the condenser and hand-hole cover on the end of the nozzle case.

OPERATION

Vapors entering the condenser at the top are condensed by water from the spray nozzles. Non-condensables are drawn into the tail-piece of the condenser by the converging water stream from the jet nozzles. Condensing water and non-condensables are discharged through the tail pipe at the bottom.

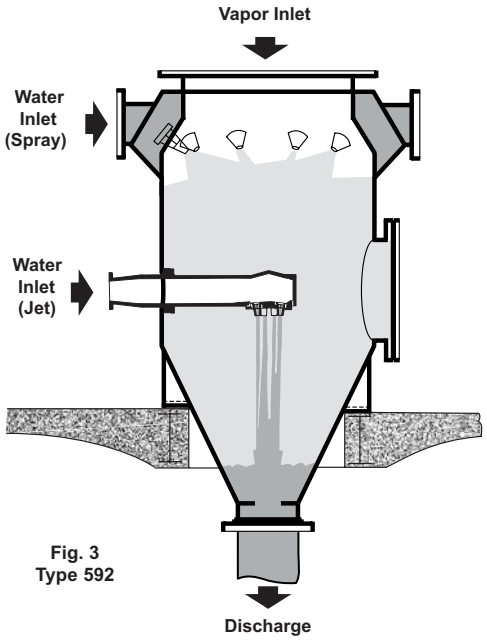


Fig. 3
Type 592

TABLE 2. SIZES, CAPACITIES, DIMENSIONS, AND WEIGHTS OF S&K MULTI-JET SPRAY TYPE BAROMETRIC CONDENSERS, TYPE 592

Size No.	Maximum Water Capacity, gpm	Connections, Inches				Overall Dimensions, Feet and Inches		Approx. Weight, Lb.	
		Vapor Inlet A	Water Inlet		Disch. C	D	E	C.I.	FAB. ST.
			S	J					
30	625	20	5	5	6	2' 10 1/2"	5' 7"	1800	1200
31	750	24	5	5	6	3' 4"	6' 2"	2300	1500
32	950	24	5	5	8	3' 4"	6' 2"	2600	1700
33	1100	30	6	6	8	3' 11 1/4"	6' 3 3/4"	4400	2400
34	1300	30	6	6	8	3' 11 1/4"	6' 3 3/4"	4500	2500
35	1700	30	8	6	10	4' 3"	6' 10 3/8"	6000	3200
36	2200	36	8	8	10	4' 10 1/4"	7' 10"	8000	4000
37	3200	42	10	8	12	5' 4"	9' 7"	10000	5000
38	3800	48	10	8	12	5' 11 1/4"	10' 6"	11000	5500
39	5000	54	12	12	14	6' 11 1/2"	11' 2"	11000	7500
40	6000	60	14	12	16	7' 6 1/2"	11' 10"	14000	8750
41	8000	60	14	12	18	7' 6 1/2"	11' 10"	16000	9500
42	9000	66	16	14	20	9' 2"	13' 4"	20000	11000
43	12000	72	18	16	24	10'	15'	22000	13000

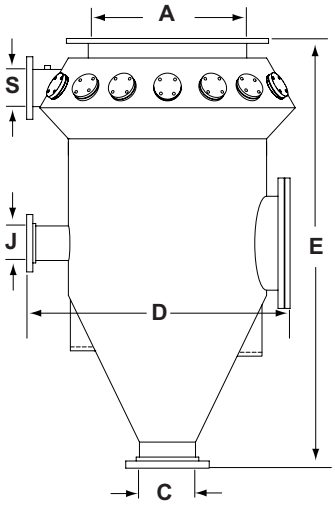
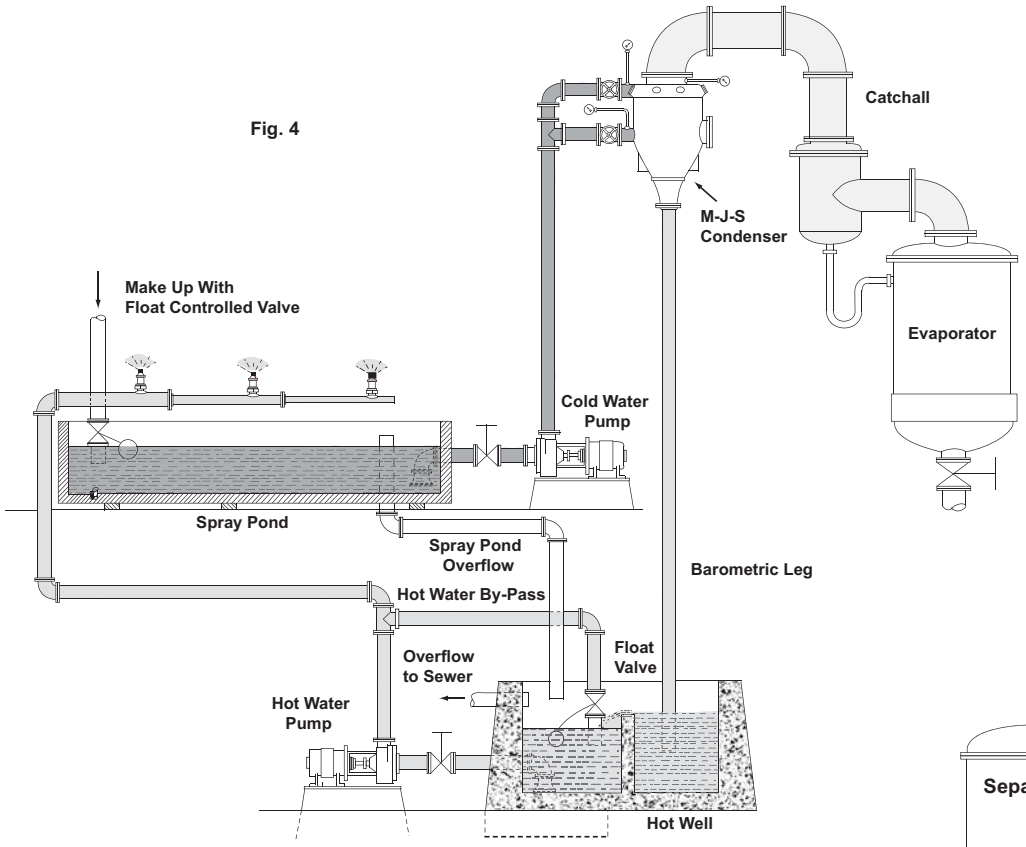


Fig. 4



S&K MULTI-JET SPRAY TYPE (M-J-S) BAROMETRIC CONDENSERS

Fig. 5 illustrates a typical use of a standard Multi-Jet Spray Barometric Condenser with evaporators. The steam vapors from the evaporator pass through a separator or catch-all, where any liquid carried in suspension is collected and drained back into the evaporator. The vapors pass on to the top inlet of the condenser where the condensing is accomplished by the spray nozzles. The water jets entrain the air and non-condensable gases and discharge them into the barometric tail pipe which drains by gravity into a hot-well. Condensing water is delivered to the nozzles at a slight positive pressure (4 to 5 lbs.), but with light steam loads, the injection water may be throttled and water flow adjusted to meet the vapor load. As indicated in the illustration, no air pumps are required and the installation is simple and foolproof.

In cases where there is a shortage of cooling water, it is necessary to apply a re-cooling system. This is done effectively by a spray pond arrangement, as shown in Fig. 4. Two centrifugal pumps are employed; one for delivering the warm water from the hot-well to the spray pond, the other for pumping the cooled injection water to the condenser. Automatic level control is provided by an overflow pipe from spray pond to hot-well.

PERFORMANCE

As with other Barometric Condensers, the Multi-Jet Spray has no moving parts in the vacuum chamber. Due to this simplicity of design, high performance with easy operation can be anticipated. See performance curve on page 11. The absence of moving parts and vacuum pumps reduces downtime associated with equipment involving moving parts. The Multi-Jet Spray Barometric Condenser operates with a small terminal temperature difference (11 to 13°F) and maintains high vacuums in spite of heavy fluctuations in water temperature and steam load. The nozzles are accessible through the handholes.

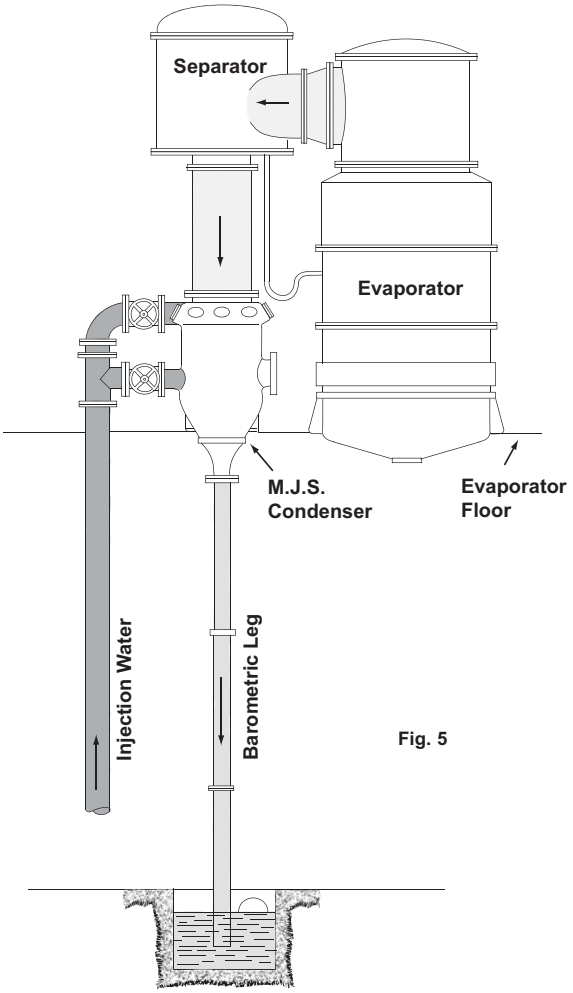


Fig. 5

S&K MULTI SPRAY (M-S) BAROMETRIC CONDENSERS

APPLICATION

Although the S&K Multi-Spray Barometric Condenser was developed primarily to solve condensing problems where water supply is limited, it is also well suited in operations where water temperatures are high in relation to vacuum requirements, or where a large volume of non-condensables must be removed.

CONSTRUCTION

Body construction of the S&K Multi-Spray Condenser is very similar to that of the Multi-Jet Spray design and the circular spray nozzle arrangement at the top of the unit is the same. No jet type nozzles are used, however.

The bronze spray nozzles are specially designed with spiral construction cast as an integral part of the nozzle housing. They have an orifice diameter of not less than one inch and are not subject to clogging, provided the water supply is protected by a screen or strainer having 1/4 or 3/8 inch mesh. The nozzles are readily accessible from the outside by means of inspection openings located opposite each nozzle. See page 12 for details on these nozzles.

OPERATION

The S&K Multi-Spray Condenser operates with a terminal difference down to 5°F. Vapor enters the condenser at the top and is thoroughly mixed with injection water which is delivered through several spray nozzles. The downward action of these converging sprays creates a suction in addition to their condensing action. Vapors condensed in the spray chamber are delivered with condensing water to the hot-well through a barometric leg.

The non-condensables are drawn through an air suction chamber to a pre-cooler, where water delivered by a spray nozzle lowers the temperature of the air-vapor mixture and condenses practically all of the vapor. The remaining mixture delivered to the air pump is at a temperature close to that of the spray water which reduces to a minimum the amount of condensable vapors removed by the air pump. Note the self-draining design feature which avoids corrosion and clogging during seasonal shut-downs.

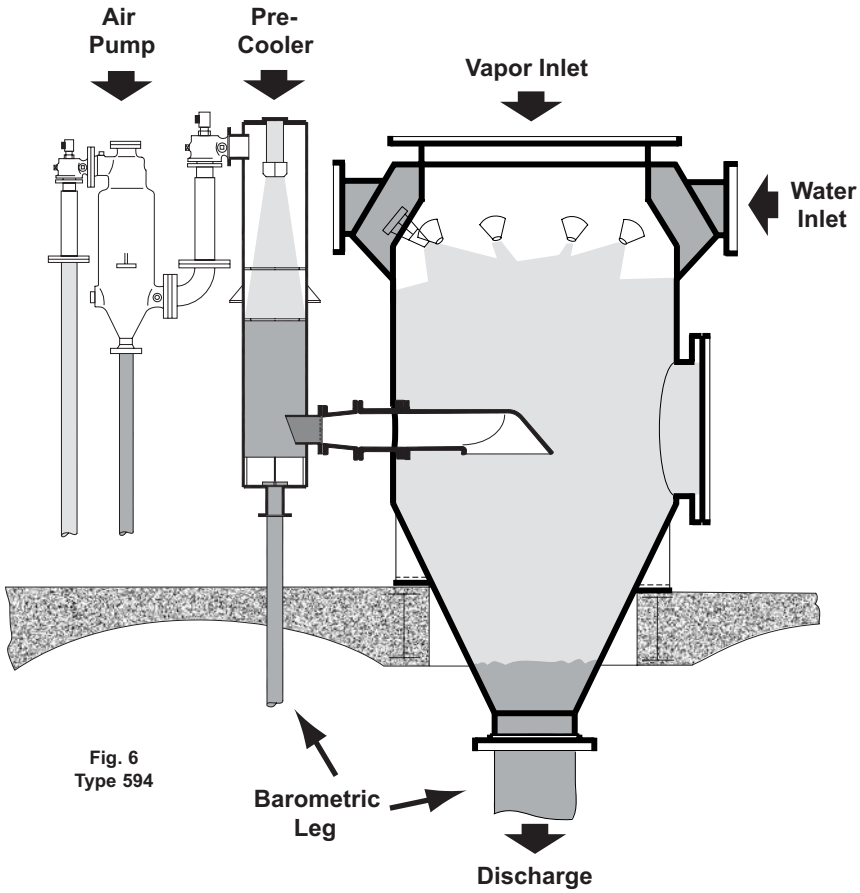


Fig. 6
Type 594

S&K MULTI SPRAY (M-S) BAROMETRIC CONDENSERS

PERFORMANCE

The S&K Multi-Spray Barometric Condenser offers a number of advantages in its design which provide efficient performance. The parallel flow design, with top vapor inlet, effectively prevents flooding under all circumstances. Also, the absence of distributing trays in the Multi-Spray design is a distinct advantage, because trays could sometimes be clogged or fouled and give poor water distribution, thus permitting steam to reach the air pump. In the counter-current condenser the pressure drop between side vapor inlet and top air pump suction increases with vapor load and water flow. This serious disadvantage is entirely overcome with the multi-spray design. In addition, the required shell diameter is less, offering savings in space and cost.

The distribution of injection water in the form of converging sprays insures an excellent mixing of the water and incoming vapors. Also, the downward direction of the sprays creates a suction effect which eliminates pressure drop in the condenser chamber. To meet varying load and temperature conditions, the water can be throttled to a minimum pressure drop of 10 psia across the nozzles.

The small barometric pre-cooler attached to the condenser of the Multi-Spray acts as an air cooler and prevents any possibility of water getting into the air pump. It insures efficient operation of the air pump by delivering an air-vapor mixture cooled close to the injection water temperature.

It is possible in a well designed "tight" system to obtain terminal differences as low as 3 to 5°F, but it must be remembered that the non-condensables are removed by an adequate air pump, so that no additional injection water is required to handle the non-condensables.

In case of a breakdown or necessary repairs to the air pump, it is highly desirable to be able to operate without it and still maintain an adequate vacuum. The downward suction effect of the Multi-Spray sprays makes it possible in an emergency to operate this type of condenser without air pump for short periods at slightly less vacuum.

For performance data, refer to the curve on page 11.

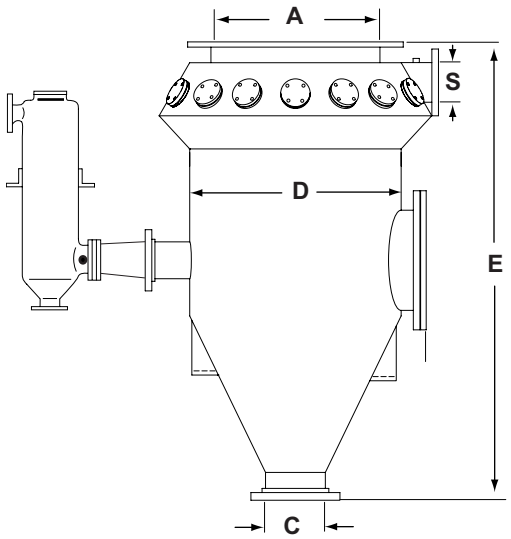


TABLE 3. SIZES, CAPACITIES, DIMENSIONS, AND WEIGHTS OF S&K MULTI-SPRAY BAROMETRIC CONDENSERS, TYPE 594

Size No.	Maximum Water Capacity, gpm	Connections, Inches			Overall Dimensions, Feet and Inches		Approx. Weight, Lb.	
		Vapor Inlet A	Water S	Disch. C	Shell Dia. D	E	C.I.	FAB. ST.
30	625	20	6	6	2' 2"	5' 7"	1800	1200
31	750	24	6	6	2' 8"	6' 2"	2300	1500
32	950	24	8	8	2' 8"	6' 2"	2600	1700
33	1100	30	8	8	2' 11"	6' 3 3/4"	4400	2400
34	1300	30	8	8	2' 11"	6' 3 3/4"	4500	2500
35	1700	30	8	10	3' 4"	6' 10 3/8"	6000	3200
36	2200	36	10	10	3' 10"	7' 10"	8000	4000
37	3200	42	12	12	4' 4"	9' 5 1/2"	10000	5000
38	3800	48	12	12	4' 10"	10' 4 1/2"	11000	5500
39	5000	54	14	14	5' 8"	11' 2"	12500	7500
40	6000	60	16	16	6' 2"	11' 10"	14000	8750
41	8000	60	16	18		12' 6"	16000	9500
42	9000	66	20	20		13' 4"	20000	11000

S&K COUNTER-CURRENT (C-C) BAROMETRIC CONDENSERS

APPLICATION

Where water supply is limited or an excessive amount of non-condensables requires the use of a separate vacuum pump, and local conditions necessitate a side vapor inlet, S&K Barometric Counter-Current Condensers, Type 597 is the only S&K Condenser available in small sizes to meet the requirements of the above conditions.

CONSTRUCTION

The Type 598 Condenser consists of a cylindrical body with side vapor inlet, top water inlet, and internal distribution trays. Available in sizes No. 18 and larger, they have fabricated construction.

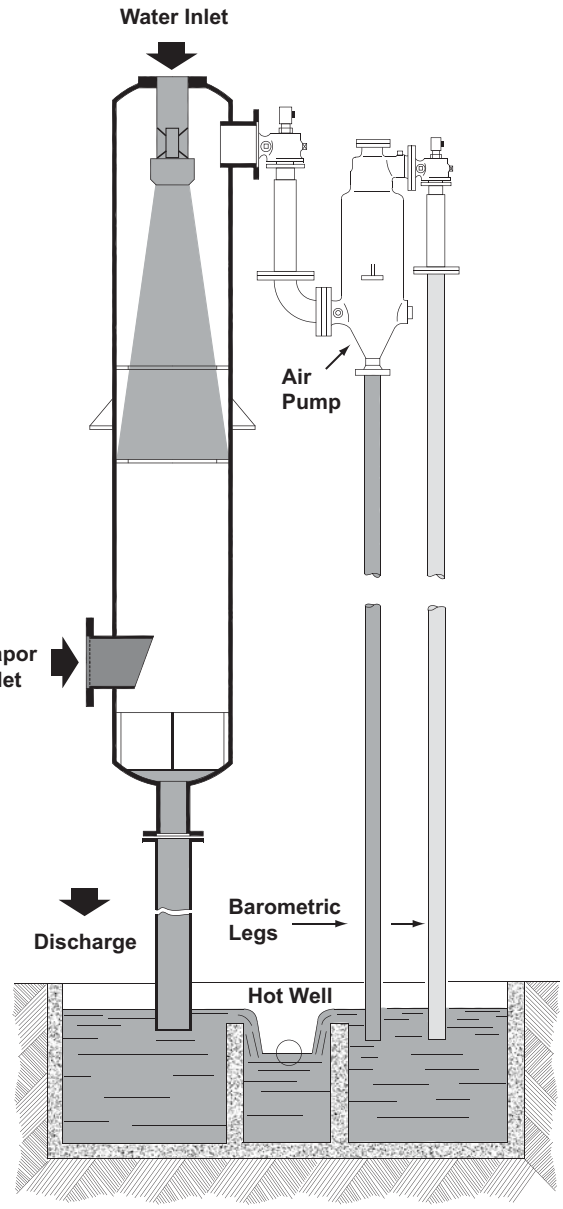


Fig. 7.
Type 598

Type 597 Condensers are made in sizes No. 0 through 5, in cast iron or Haveg and Polyester Fiberglass. They utilize a spray nozzle for initial water distribution, and a tray to maintain the proper curtains.

S&K Counter-Current Condensers of this type require a separate steam jet vacuum pump as described in Bulletin 5EH. The illustration of a Type 598 installation shows a typical barometric arrangement with auxiliary air pump.

OPERATION

In both the Type 597 and Type 598 units, injection water enters the condenser through a water nozzle at the top of the unit. A distribution tray in the shell provides a "water curtain" through which the vapor must pass. The spray nozzles are located to provide maximum effective distribution independent of the leveling of the condenser.

Most of the vapor entering the condenser is condensed in the lower part of the shell, and the non-condensables are then required to travel upward through the water curtains. A baffle arrangement is provided at the air suction connection to reduce to a minimum the carry-over of water that may have been entrained as the air passes through the condenser.

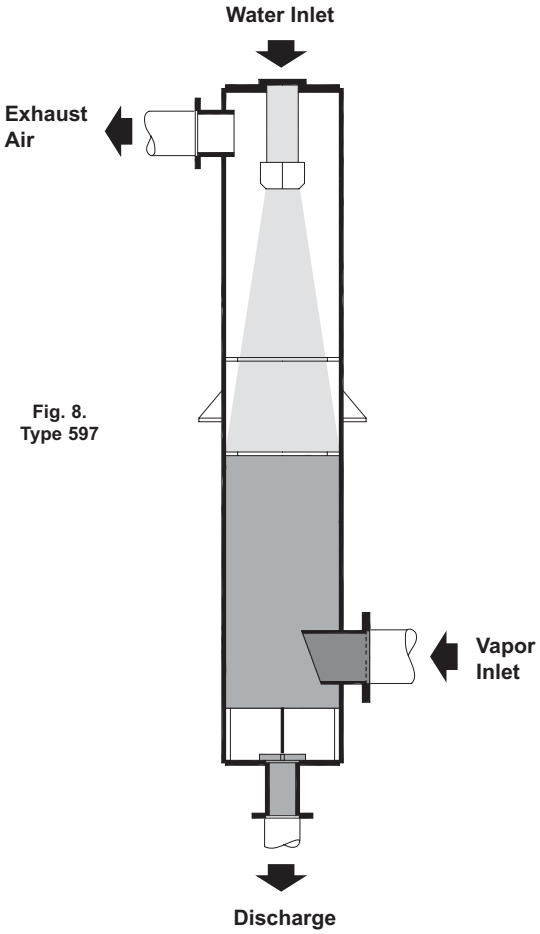


Fig. 8.
Type 597

S&K COUNTER-CURRENT (C-C) BAROMETRIC CONDENSERS

PERFORMANCE

The counter-current Barometric Condenser can operate with terminal differences of 3 to 5°F between tail water and vapor dew point temperature. Large condensers will cool the non-condensables to within 5°F of the inlet water temperature. In cases where large percentages of non-condensables are present, however, terminal differences as high as 30°F to 50°F may be expected since the condenser is actually performing as a gas cooler. This is particularly true where counter-current condensers are used as intercondensers for multi-stage steam jet vacuum pumps (see Bulletin 5-EH).

As in other S&K Condensers, there are no moving parts in the Counter-Current Condenser. Also, little maintenance is required and provision can be made for internal inspection of the unit. Because of the barometric leg, no water removal pump is required. Due to efficient cooling of non-condensables, the supporting vacuum pump requires a minimum of live steam for efficient operation. S&K Counter-Current Condensers can be supplied in cast iron or steel plate, as well as most special materials. The construction also lends itself readily to rubber lining.

For performance data, refer to the curve on page 11.

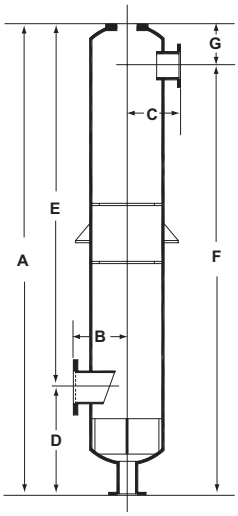


TABLE 4. TYPICAL SIZES, CAPACITIES, DIMENSIONS, AND WEIGHTS OF S&K COUNTER-CURRENT BAROMETRIC CONDENSERS, TYPES 597, AND 598

Size	Normal Water Capacity gpm	Dimensions in Inches							Connections in Inches				Net Wgt. In Lbs.
		A	B	C	D	E	F	G	Water Inlet	Vapor Inlet	Vapor Outlet	Disch.	
TYPE 597 (CAST IRON)													
0	24	35 1/2	7 7/16	6	8	27 1/2	32 1/4	3 1/4	1	3	2	2	150
1	40	53	7	6	11	42	48 1/2	4 1/2	2	4	2	3	225
2	95	69 1/8	10	9	14	55 1/8	64 1/4	4 7/8	2 1/2	6	2 1/2	4	475
3	160	81 3/4	12	12	16	65 3/4	76 1/2	5 1/4	3	8	3	4	750
4	200	91 1/4	13	13	18 1/4	73	85 1/4	6	4	10	4	5	1040
5	250	101 1/4	14	14	20 3/4	80 1/2	94 1/4	7	4	12	6	6	1270
TYPE 598 (FABRICATED STEEL)													
18	200	91 1/4	13	13	18 1/4	73	85 1/4	6	4	10	4	5	1075
20	250	101 1/4	14	14	20 3/4	80 1/2	94 1/4	7	4	12	6	6	1175
22	310	121	15	15	28	93	114	7	6	12	6	6	1300
26	430	145	18	18	35	110	138	7	6	14	6	8	1500
30	570	158	19	19	36	122	151	7	8	16	6	8	2000
36	830	182	22	22	39	143	174	8	8	20	8	10	2700
42	1130	203	27	27	41	162	195	8	10	24	8	12	4100
48	1470	239	29	29	43	196	217	22	12	28	10	14	4700
54	1870	260	31	31	44	216	237	23	14	30	10	16	5900
60	2320	285	35	35	46	239	260	25	16	32	12	18	8200
66	2800	307	39	39	48	259	281	26	16	36	12	18	9300
72	3350	329	42	42	51	278	303	26	18	42	14	20	12400
78	3940	351	45	45	51	300	324	27	20	42	16	20	15000
84	4600	374	49	49	54	320	345	29	20	48	16	24	18500
90	5200	398	54	54	54	344	366	32	24	48	18	24	22000
96	6000	423	58	58	56	367	387	36	24	54	20	30	26000

PERFORMANCE DATA
BAROMETRIC CONDENSERS

The air removal capacity of the water jets in the M-J Barometric Condenser is usually greater than that of mechanical vacuum pumps used with ordinary barometric condensers of equal capacity. This feature is clearly illustrated in Fig. 9. These curves plot the results of a comparative test between a Multi-Jet Condenser and a dry air pump. The test was made to establish the time required for priming a large vacuum pan in a sugar mill.

A Multi-Jet Condenser, without auxiliary air pump, was installed to replace a counter-current barometric condenser equipped with motor-driven dry vacuum pump. As shown in the curves, the Multi-Jet Condenser produced a vacuum of 28 inches Hg with injection water at 80°F; the dry vacuum pump, however, raised the vacuum to only 25 inches Hg in the same time (20 minutes). These tests were made on a cold and empty pan of 2600 cu. ft. volume. The horsepower input to the previously used dry vacuum pump was equivalent to the power input to the Multi-Jet Condenser without auxiliary air pump. With liquid in the pan, the starting period was greatly reduced and only a few minutes were required to establish the vacuum.

COMPARATIVE PRIMING PERFORMANCE BETWEEN MULTI-JET CONDENSER AND DRY VACUUM PUMP

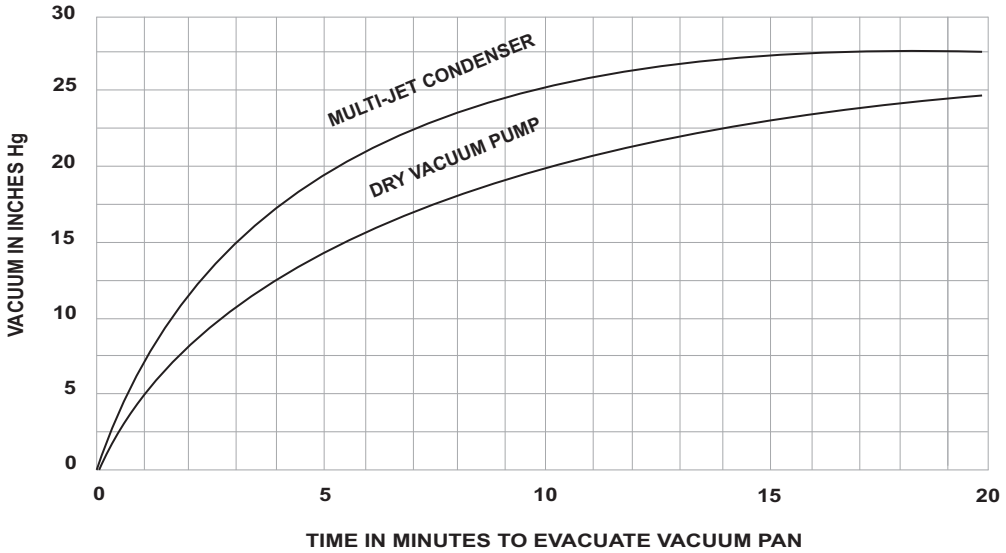


Fig. 9

PERFORMANCE CURVE FOR MULTI-JET AND MULTI-JET SPRAY BAROMETRIC CONDENSERS, TYPES 590, 591 AND 592.

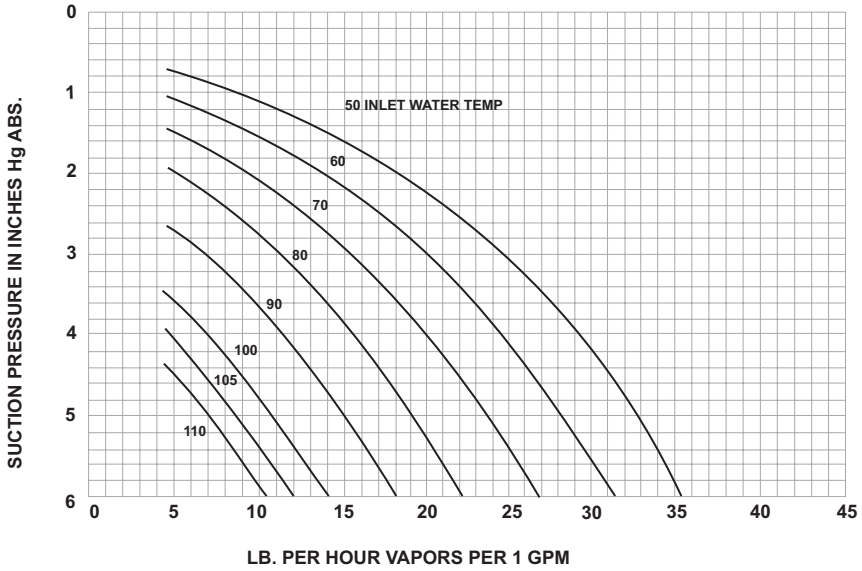


Fig. 10A

PERFORMANCE CURVE FOR MULTI-JET, TYPE 594, AND COUNTER-CURRENT BAROMETRIC CONDENSERS, TYPE 597/598.

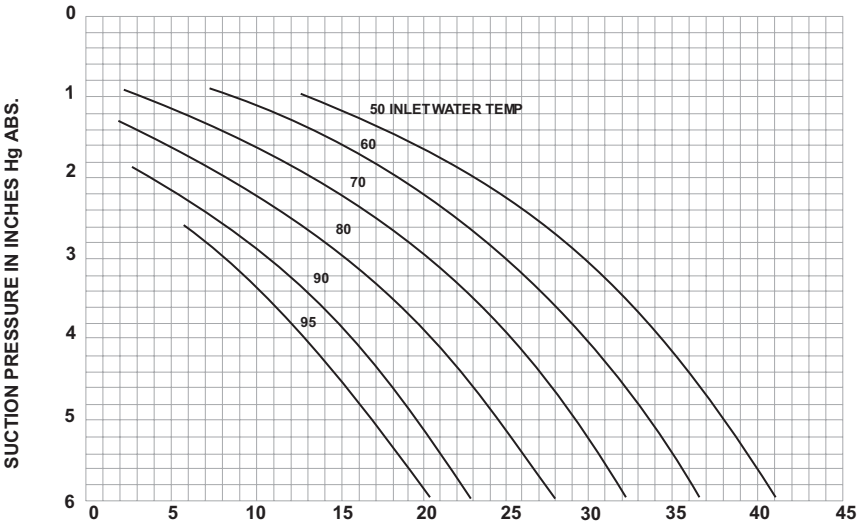
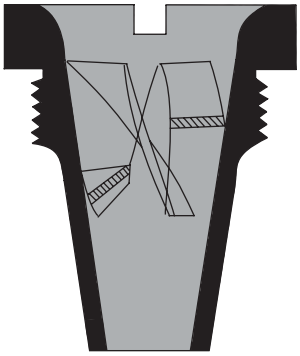


Fig. 10B

S&K NON-CLOGGING SPRAY NOZZLES

As noted in the descriptions of S&K Type 592 Condensers on pages 4 & 5 and S&K Type 594 Condensers on pages 6 & 7, both of these units are equipped with S&K Non-Clogging Nozzles of the type shown in the sectional drawing right.

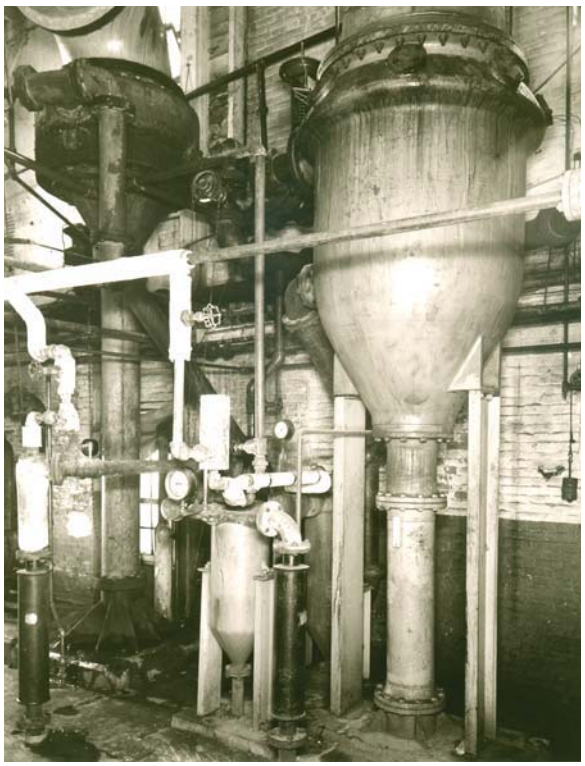


These nozzles are normally made of bronze and are investment castings. Monel or stainless steel nozzles can be supplied on order.

The spiral of the nozzle consists of three vanes which are cast directly into the inside wall. These vanes are designed to give the proper angle of spray and to provide adequate space between the vanes and through the center of the nozzle to assure free passage of foreign particles. Since the vanes are cast into the wall, they cannot change position as a separate piece might do. The spray angle of an S&K Non-Clogging Nozzle, therefore, will always remain the same.

TYPICAL INSTALLATIONS OF BAROMETRIC CONDENSERS

To increase efficiency and cut the time required to dehydrate whole fish into fish meal, rich in proteins, vitamins, and minerals, a large marine products company installed seven S&K M-J Barometric Condensers at each of two plants - a total of fourteen.



Two of eight S&K M-J and M-J-S Barometric Condensers installed in a large sugar refinery are shown in this photo. For over fifty years, S&K has been furnishing this type of equipment to major sugar manufacturers in the United States and abroad.